TITLE OF THE INVENTION

PAPER-FEEDING APPARATUS OF AN IMAGE FORMING APPARATUS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the priority of Korean Patent Application No. 2003-23790, filed on April 15, 2003, in the Korean Intellectual Property Office, the disclosure of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0002] The present invention relates to a paper-feeding apparatus of an image forming apparatus, such as a copier, a printer, and a fax machine, and more particularly, to a paper-feeding apparatus of an image forming apparatus, which can prevent paper feed difficulties, for example, a paper jam, and a paper skew, and enhance paper-feeding accuracy of a feed roller, by removing a drag force generated by drive rollers during the line feeding of paper.

2. Description of the Related Art

[0003] An image forming apparatus such as a copier, a printer, and a fax machine, generally has a paper-feeding apparatus feeding sheets of paper to an image forming unit.

[0004] As is shown in FIGS. 1 and 2, such a paper-feeding apparatus 10 comprises a paper cassette 20 stacking sheets of paper P, a frame 11 receiving and detachably mounting the paper cassette 20 therein, a pickup unit 30 installed at the frame 11 with respect to the paper cassette 20 and picking up the sheets of paper P one by one, and a paper feeding unit 40 installed at the frame 11 with respect to the paper cassette 20 and conveying the sheet of paper P picked up by the pickup unit 30.

[0005] The pickup unit 30 is composed of a pickup roller assembly 31 supported at the frame 11 to rotate with respect to a supporting shaft 35, and a pickup roller driving motor 33 driving the pickup roller assembly 31 through a power transmitting gear train 37.

[0006] The pickup roller assembly 31 is provided with: pickup rollers 34 picking up the sheets of paper P one by one; a first one-way power transmitter (not shown), such as a spring clutch transmitting only a rotating force in a paper pickup direction between the pickup rollers 34 and a pickup roller gear (not shown) positioned coaxially with the pickup rollers 34; and a housing 36 having one end supported on a pickup roller shaft 34a and an other end rotatably fixed on the supporting shaft 35, to enable the pickup rollers 34 to contact the sheets of paper P with a predetermined pressure, by a weight thereof.

[0007] As is shown in FIG. 2, the paper feeding unit 40 is provided with a drive roller 41 and a drive backup roller 42 conveying the sheet of paper P picked up by the pickup rollers 34 , and a feed roller (not shown) feeding the sheet of paper P conveyed by the drive and the drive backup rollers 41, 42 to an image forming unit (not shown).

[0008] The drive roller 41, which is connected with the pickup roller driving motor 33 through a drive roller gear train (not shown) having a second one-way power transmitter, such as a spring clutch, is driven in the paper pickup direction during the pickup of paper, and idles during the line feeding of paper.

[0009] The operation of the conventional paper-feeding apparatus 10 constructed as above is described as follows.

[0010] Firstly, with a printing command, the pickup rollers 34 are rotated in the clockwise direction by the pickup roller assembly 31 of the pickup unit 30, which is connected to the pickup roller driving motor 33 through the power transmitting gear train 37.

[0011] As a result, the pickup rollers 34 contact and pick up the sheets of paper P stacked in the paper cassette 20 sheet by sheet. At this time, among the sheets of paper P, only an uppermost sheet of paper P is conveyed toward the drive and the drive backup rollers 41, 42 by a rotating force in the clockwise direction of the pickup rollers 34, and a friction resistance of friction bucklers or dams 39 installed in the paper cassette 20.

[0012] After that, the sheet of paper P is conveyed to the feed roller and a feed backup roller by the drive roller 41 and drive backup roller 42, connected to the pickup roller driving motor 33 through the drive roller gear train.

[0013] Subsequently, when the sheet of paper P operates a paper sensor (not shown) installed in the vicinity of the feed roller, a controller (not shown) stops the pickup rollers 34 after a predetermined time elapses, that is, after a leading end of the sheet of paper P is curled and aligned by a nip between the feed and the feed backup rollers. Then, the controller drives a feed roller driving motor (not shown) to drive the feed roller.

[0014] At this time, the pickup rollers 34 and the drive roller 41 are subjected to the rotating force in the clockwise direction by the sheet of paper P, but are idled, respectively, by the first one-way power transmitter of the pickup roller assembly 31 and the second one-way power transmitter of the drive roller gear train.

[0015] And then, the sheet of paper P is fed to the image forming unit by the feed roller, printed at the image forming unit, and then discharged.

[0016] But in the conventional paper-feeding apparatus 10, since the pickup roller assembly 31 and the drive roller gear train have the first and second one-way power transmitters respectively, when the feed roller is driven by the feed roller driving motor to feed the sheet of paper P after the pickup of paper, it is subjected to a drag force corresponding to a force of idling the pickup rollers 34 and the drive roller 41, respectively against the first one-way power transmitters of the pickup roller assembly 31 and the second one-way power transmitters of the drive roller gear train, as well as a weight of the pickup roller assembly 31 and a pressure between the drive and the drive backup rollers 41, 42 which are acting on the sheet of paper P.

[0017] The drag force acting on the feed roller not only reduces a paper-feeding accuracy of the feed roller, but also, in the worst case, may cause the sheet of paper P to be skewed or jammed.

[0018] Also, in the conventional paper-feeding apparatus 10, since a vector of force, acted on the sheet of paper P by the weight and the like of the pickup roller assembly 31, acts contrary to that of the rotating force acted on the sheet of paper P by the pickup rollers 34 during the pickup of paper, there is a problem that a rotating resultant force of the pickup rollers 34 during the pickup of paper is decreased, and thereby a paper pickup efficiency of the pickup rollers 34 is reduced.

[0019] If the paper pickup efficiency of the pickup rollers 34 is reduced, difficulties, such as the sheet of paper P not being picked up, or the sheet of paper P being jammed by the pickup rollers 34, may occur.

SUMMARY OF THE INVENTION

[0020] It is one aspect of the present invention to provide a paper-feeding apparatus of an image forming apparatus, which is constructed not to have a drag force generated by drive rollers during line feeding of paper, thereby preventing paper feed troubles such as a paper jams and paper skewing, and improving a paper-feeding accuracy of a feed roller.

[0021] It is another aspect of the present invention to provide a paper-feeding apparatus of an image forming apparatus, comprising a vector of force that acts on a sheet of paper by a pickup roller assembly to act in the same direction as a vector of a rotating force that acts on the sheet of paper by pickup rollers during the pickup of paper, thereby improving a pickup efficiency of the pickup roller.

[0022] The foregoing and/or other aspects and advantages are realized by providing a paper-feeding apparatus of an image forming apparatus having first and second drive roller shafts, and a paper cassette, the paper-feeding apparatus including: a first drive roller, rotatably disposed on the first drive roller shaft; a pickup roller assembly, rotatably disposed, at a first end thereof, on the first drive roller shaft; a pickup roller, rotatably disposed at a second end of the pickup roller assembly to selectively move a sheet of paper in the paper cassette in a first direction, the pickup roller being disposed in a second direction, opposite the first direction, with respect to the first drive roller; a second drive roller, rotatably disposed on the second drive roller shaft, to press the sheet of paper with a first predetermined pressure against the first drive roller; and a drive roller power transmitter transmitting a driving force to the first and second drive rollers and the pickup roller during a paper pickup mode, and transmitting the driving force only to the first and second drive rollers during a line feeding mode.

[0023] The foregoing and/or other aspects and advantages are also realized by providing A paper-feeding apparatus of an image forming apparatus, including: a first drive roller; a pickup roller; a second drive roller; a swing gear part selectively transmitting a driving force to one of

the first drive roller and the second drive roller, and a one-way power transmitting part disposed coaxially with the first drive roller, transmitting the driving force to the pickup roller only when the first drive roller is rotated in a first rotational direction.

[0024] Additional aspects and/or advantages of the invention will be set forth in part in the description which follows and, in part, will be obvious from the description, or may be learned by practice of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] These and/or other aspects and advantages of the invention will become apparent and more readily appreciated from the following description of the embodiments, taken in conjunction with the accompanying drawings of which:

FIG. 1 is a perspective view of a conventional paper-feeding apparatus of an image forming apparatus;

FIG. 2 is a side elevation view of the paper-feeding apparatus of FIG. 1;

FIG. 3 is a schematic side elevation view of a paper-feeding apparatus of an image forming apparatus according to an embodiment of the present invention;

FIG. 4 is a partial top plan view illustrating the connection relation among a pickup roller assembly, a one-way power transmitting part, and a drive roller part of the paper-feeding apparatus of FIG. 3;

FIG. 5 is a perspective view illustrating a modified example of a pickup roller assembly lifter of a paper-feeding apparatus according to a second embodiment of the present invention; and

FIGS. 6A and 6B are side elevation views illustrating the operation of the pickup roller assembly lifter of the paper-feeding apparatus of FIG. 5.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0026] Reference will now be made in detail to embodiments of the present invention, examples of which are illustrated in the accompanying drawings, wherein like reference

numerals refer to the like elements throughout. The embodiments are described below to explain the present invention by referring to the figures.

[0027] Referring to FIG. 3, there is illustrated a paper-feeding apparatus 100 of an image forming apparatus of the present invention.

[0028] The paper-feeding apparatus 100 of the present invention comprises a paper cassette 120 stacking sheets of paper P, a frame (not shown) receiving and detachably mounting the paper cassette 120, a pickup unit 130 installed at the frame with respect to the paper cassette 120 and picking up the sheets of paper P sheet by sheet, and a paper feeding unit 140 installed at the frame and feeding the sheet of paper P picked up by the pickup unit 130.

[0029] At a leading end (that is, a left side of the drawing) of the paper cassette 120 are installed a plurality of friction bucklers 128 to pick up and feed one sheet of paper P at a time during the pickup of paper.

[0030] The pickup unit 130 comprises: a pickup roller assembly 131 fixed rotatably with respect to a first drive roller shaft 142a of a drive roller part 141, which is fixed at the frame to rotate in association with a driving motor (155 to be described later); and a pickup roller assembly lifter 150, selectively contacting and separating pickup rollers 134, 134' of the pickup roller assembly 131, with and from the sheets of paper P, according to a rotating direction of the first drive roller shaft 142a, to contact the pickup roller 134, 134' with the sheets of paper P during the pickup of paper.

[0031] The pickup roller assembly 131 comprises: two pickup rollers 134, 134' rotatably fixed on a pickup roller shaft 134a to pickup the sheets of paper P one by one; a pickup driving gear 139 positioned on the first drive roller shaft 142a to be driven by the driving motor 155; a pickup roller gear 135 positioned coaxially with the pickup rollers 134, 134' on the pickup roller shaft 134a; first, second, and third idle pickup gears 136, 137, 138 disposed between the pickup driving gear 139 and the pickup roller gear 135, and fixed respectively on first, second, and third idle pickup shafts 136a, 137a, 138a, to transmit a driving power of the driving motor 155 from the pickup driving gear 139 to the pickup roller gear 135; and a housing 133 receiving the gears 135, 136, 137, 138, 139, and supporting the respective shafts 134a, 136a, 137a, 138a, 142a.

[0032] According to one aspect, to assure that a vector of force of the pickup roller assembly 131 acts on the sheets of paper P, that is, its own weight and a gearing force of a first drive roller gear 143 to be described later, acts in the same direction as that of a rotating force of the pickup rollers 134 and 134' acting on the paper P during the pickup of the paper P, the first drive roller shaft 142a is disposed such that a vertical plane extended vertically at a center thereof is positioned downstream in a paper pickup path, as compared with a vertical plane of the pickup roller shaft 134a (to the left of the pickup roller shaft 134a in FIG. 3).

[0033] According to one aspect, the pickup roller assembly lifter 150 comprises a first elastic spring installed on the first drive roller shaft 142a with respective ends supported at a first supporting projection (not shown) positioned at the frame, and a second supporting projection 133a positioned at the housing 133 of the pickup roller assembly 131.

[0034] The first elastic spring of the pickup roller assembly lifter 150 is compressed by the gearing force of the first drive roller gear 143 to rotate the pickup roller assembly 131 into a descent position (a solid line of FIG. 3), about the first drive roller shaft 142a, when the first drive roller gear 143 is subjected to a force of rotating in a clockwise direction by the driving power of the driving motor 155. When the first drive roller gear is not subject to the force of rotating in the clockwise direction by the driving motor 155, stored energy of the compressed first elastic spring subjects the pickup roller assembly 131 to another force of rotation about the first drive roller shaft 142a, and restores the pickup roller assembly 131 into an ascent position (a dotted line of FIG. 3). In the descent position, the pickup rollers 134 and 134' are in contact with the sheets of paper P with a first predetermined pressure, and in the ascent position, the pickup rollers 134 and 134' are separated from the sheets of paper P.

[0035] The paper feeding unit 140 comprises the drive roller part 141 to convey the sheet of paper P picked up by the pickup roller assembly 131, a feed roller part 146 to feed the sheet of paper P to an image forming unit (not shown), a discharging roller part 165 to discharge the sheet of paper P printed at the image forming unit to the outside, and the driving motor 155 to drive the drive roller part 141, the feed roller part 146 and the discharging roller part 165.

[0036] As is shown in FIG. 4, the drive roller part 141 comprises two first drive rollers 142 and 142' supported rotatably on the first drive roller shaft 142a fixed rotably at the frame, downstream in the paper pickup direction of the pickup rollers 134, 134', and two second drive

rollers 144 and 144' fixed on a second drive roller shaft 144a, to press the sheet of paper P with a second predetermined pressure against the first drive rollers 142 and 142'.

[0037] On one end of the respective first and the second drive roller shafts 142a and 144a, the first drive roller gear 143 and a second drive roller gear 145 (only shown in FIG. 3), each of which engages with a first or a second idle swing gears 162 or 163 of a swing gear part 160 forming a drive roller power transmitter to be described later, are coaxially fixed with the first and the second drive rollers 142, 142';144, 144', respectively.

[0038] The feed roller part 146 comprises: a feed roller gear 148 positioned on a feed roller shaft 147a to rotate in association with first and second power transmitting gears 156 and 157 connected with a motor shaft 155a of the driving motor 155; a feed roller 147 positioned coaxially with the feed roller gear 148 on the feed roller shaft 147a; and a friction roller 149 rotatably disposed on a friction roller shaft 149a, pressing the sheet of paper P with a third predetermined pressure against the feed roller 147, to convey the sheet of paper P.

[0039] The friction roller 149 includes a friction roller holder 158 supported at the frame to exert a predetermined pressing force on the friction roller 149 by an elastic spring (not shown).

[0040] A drive roller power transmitter 160; 170, 170', is disposed between the drive roller part 141 and the feed roller part 146, to transmit the driving power of the driving motor 155 from the feed roller gear 148 of the feed roller part 146 to the first drive roller 143 of the drive roller part 141. This drives the pickup rollers 134, 134' and the first and the second drive rollers 142, 142'; 144, 144', respectively, in a paper pickup direction and a paper feeding direction (arrows of solid line in FIG. 3) during the pickup of paper, and transmits the driving power of the driving motor 155 from the feed roller gear 148 of the feed roller part 146 to the second drive roller 145 of the drive roller part 141, thereby to allow only the first and the second drive rollers 142, 142'; 144, 144' to be driven in a paper feeding direction (arrows of dotted line in FIG. 3) during the line feeding of paper.

[0041] The drive roller power transmitter 160; 170, 170' comprises: a swing gear part 160 disposed among the first and the second drive roller gears 143 and 145 of the drive roller part 141, and the feed roller gear 148 connected with the driving motor 155a through the first and the second power transmitting gears 156 and 157 to convey the sheet of paper P, and interconnecting between the feed roller gear 148 and the first drive roller gear 143 or between

the feed roller gear 148 and the second drive roller gear 145, according to a rotating direction of the feed roller gear 148.

[0042] According to one aspect, the swing gear part 160 comprises: first and second idle swing gears 162 and 163, arranged to respectively engage with the first and the second drive roller gears 143 and 145; and a swing gear 161 arranged to engage with the feed roller gear 148, formed coaxially with the feed roller 147 on the feed roller shaft 147a, and disposed to selectively connect with the first and the second idle swing gear 162 and 163, according to the rotating direction of the feed roller gear 148.

[0043] A shaft 161a of the swing gear 161 is rotatably fixed at one end of a swing lever (not shown) hinged on the frame at the other end thereof, so that the swing gear 161 can be selectively connected with the first and the second idle swing gear 162 and 163, according to the rotating direction of the feed roller gear 148.

[0044] More specifically, as is shown in solid line arrows in FIG. 3, when the feed roller gear 148 rotates in an counter-clockwise direction to pick up a sheet of paper P, the swing gear 161 is engaged with the first idle swing gear 162 by the swing lever, whereas as shown in dotted line arrows in FIG. 3, when the feed roller gear 148 is rotated in clockwise direction to feed the sheet of paper P, the swing gear 161 is engaged with the second idle swing gear 163 by the swing lever.

[0045] To transmit the driving power of the driving motor 155, transmitted to the first drive roller gear 143 through the swing gear 161 and the first idle swing gear 162, into the second drive rollers 144 and 144' through the first drive rollers 142 and 142' during the pickup of paper, and not transmit the driving power of the driving motor 155, transmitted to the first drive rollers 142 and 142' through the swing gear 161, the second idle swing gear 163, the second drive roller gear 145, and the second drive rollers 144 and 144', into the pickup driving gear 139 of the pickup roller assembly 131, thus idling the first drive rollers 142, 142' in the paper feeding direction during the line feeding of paper, as is shown in FIG. 4, the drive roller power transmitter 160; 170, 170' further comprises a one-way power transmitting part 170, 170' disposed on the first drive roller shaft 142a.

[0046] According to one aspect, the one-way power transmitting part 170, 170' comprises: two spring clutches 170and 170', having respective roller hubs 171 and 171' of the respective

first drive rollers 142 and 142' rotatably disposed on the first drive roller shaft 142a; a bushing hubs 173a and 173a' of respective bushings 173 and 173' fixed on the first drive roller shaft 142a; and clutch springs 175 and 175' coiled around the respective roller hubs 171 and 171' and the respective bushing hubs 173a and 173a', to generate a sliding friction force therebetween.

[0047] When the first drive roller gear 143 fixed on the first drive roller shaft 142a is rotated in one direction, for example, the clockwise direction, by the swing gear 161 and the first idle swing gear 162 of the swing gear part 160, the clutch springs 175 and 175' of the spring clutches 170 and 170' are coiled in a winding direction thereof. Consequently, the clutch springs 175 and 175' come in tight contact with outer circumferences of the roller and bushing hubs 171, 171'; 173a, 173a' while respective inner diameters of the clutch springs 175 and 175' get smaller due to a sliding friction force with the roller and bushing hubs 171, 171'; 173a, 173a', so that a rotating force of the bushing hubs 173 and 173' is transferred to the roller hubs 171 and 171' of the first drive rollers 142 and 142' nearby the bushing hubs 173a, 173a'. Accordingly, the rotating force of the first drive roller gear 143 is transferred to the second drive rollers 144 and 144' through the first drive rollers 142 and 142'.

[0048] On the contrary, when the first drive rollers 142, 142' are rotated in clockwise direction, by the swing gear 161 and the second idle swing gear 163 of the swing gear part 160, the second drive roller gear 145 and the second drive rollers 144 and 144', the clutch springs 175 and 175' of the spring clutches 170 and 170' are uncoiled in an anti-winding direction thereof. Consequently, the clutch springs 175, 175' are spaced from the outer circumferences of the roller and bushing hubs 171, 171'; 173a, 173a' while the inner diameters of the clutch springs 175 and 175' increase due to the sliding friction force with the roller and bushing hubs 171, 171'; 173a, 173a', so that the first drive rollers 142, 142' idle. Accordingly, the rotating force of the first drive rollers 142 and 142' is not transferred to the pickup driving gear 139 of the pickup roller assembly 131.

[0049] Here, it should be noted that in the present embodiment of the present invention, the one-way power transmitting part is illustrated and explained as composed of the spring clutches 170, 170', but the present invention is not limited to this embodiment. For example, the one-way power transmitting part may comprise a one-way power transmitting apparatus such as a ratchet.

[0050] The discharging roller part 165 comprises a discharging roller 166 connected with the driving motor 155 through a discharging roller gear train (not shown) to discharge the sheet of paper P printed at the image forming unit, and a discharging backup roller 167 disposed to press the discharging roller 166 with a fourth predetermined pressure.

[0051] Also, according to one aspect, the paper-feeding apparatus 100 further comprises a second drive roller releaser 180 to separate the second drive rollers 144, 144' from the first drive rollers 142, 142' when a sheet of paper P is jammed.

[0052] The second drive roller releaser 180 comprises: a releasing lever 181 having a first end 181a supported rotatably at the frame, and a second end 181b rotatably supporting the second drive roller shaft 144a, and movable between a releasing position (a dotted line of FIG. 3) and an engaging position (a solid line of FIG. 3); and a restoring part 183 restoring the releasing lever 181 into the engaging position after a paper jam is removed. In releasing position, the releasing lever 181 moves the second drive rollers 144 and 144' to separate from first drive rollers 142 and 142', and in the engaging position, the releasing lever 181 moves the second drive rollers 144 and 144' to engage with the first drive rollers 142 and 142' with the second predetermined pressure.

[0053] The restoring part 183 comprises a second elastic spring installed on a fixing axis 184 rotatably supported at a corresponding support (not shown) of the frame, and having ends supported respectively on a first fixing projection 185 of the releasing lever 181, and a second fixing projection (not shown) of the frame.

[0054] The second elastic spring of the restoring part 183 has an elastic force that is capable of pressing the second drive rollers 144 and 144' with the second predetermined pressure against the first drive rollers 142 and 142'.

[0055] The operation of the paper-feeding apparatus 100 of the image forming apparatus according to the present invention constructed as above will be described in detail with reference to FIGS. 3 and 4.

[0056] Firstly, when the image forming apparatus of the present invention begins operation with a printing command after mounting the paper cassette 120 in the frame, the driving motor 155 rotates in one direction, for example, the clockwise direction (an arrow of solid line in FIG.

3) to pick up a sheet of paper P, and thereby the feed roller gear 148, connected to the shaft 155a of the driving motor 155 through the first and the second power transmitting gears 156 and 157, rotates in an counter-clockwise direction.

[0057] As the feed roller gear 148 rotates in the counter-clockwise direction, the swing gear 161 is swung by the swing lever to engage with the first idle swing gear 162, and the first drive roller gear 143 engaged with the first idle swing gear 162 rotates in the clockwise direction.

[0058] As the first drive roller gear 143 rotates in the clockwise direction, the first drive rollers 142 and 142', positioned coaxially with the first drive roller gear 143 on the first drive roller shaft 142a, also rotates in the clockwise direction through the spring clutches 170 and 170' of the one-way power transmitting part.

[0059] At this time, since the bushing hubs 173a and 173a' of the spring clutches 170 and 170' rotate in the winding direction of the clutch springs 175 and 175', the clutch springs 175 and 175' come in tight contact with the outer circumferences of the roller and bushing hubs 171, 171'; 173a, 173a' while its inner diameter gets smaller, by the sliding friction force with the roller and bushing hubs 171, 171'; 173a, 173a', so that a rotating force of the bushing hubs 173a and 173a' is transferred to the roller hubs 171 and 171' of the first drive rollers 142 and 142' nearby the bushing hubs 173a and 173a'.

[0060] Accordingly, the second drive rollers 144 and 144', which are in a predetermined pressure contact with the first drive rollers 142 and 142' rotating in the clockwise direction as described above with the second predetermined pressure, rotate in the counter-clockwise direction.

[0061] Also, as the first drive roller gear 143 rotates in the clockwise direction, the pickup roller assembly 131 is moved from the ascent position (a dotted line of FIG. 3), where the pickup rollers 134 and 134' are separated from the sheets of paper P, to the descent position (a solid line of FIG. 3), where the pickup rollers 134 and 134' are in contact with the sheets of paper P with the first predetermined pressure. Moving from the ascent position to the descent position, the pickup roller assembly 131 moves against the first elastic spring of the pickup roller assembly 131 by the weight of the pickup roller assembly 131 and the gearing force of the first drive roller gear 143, and at the same time, the pickup driving gear 139, positioned coaxially

with the first drive roller gear 143 on the first drive roller shaft 142a, rotates in the clockwise direction.

[0062] Accordingly, the pickup roller gear 135, connected with the pickup driving gear 139 through the first, second, and third idle gears 136, 137 and 138, and the pickup rollers 134 and 134', which are positioned coaxially with the pickup roller gear 135 on the pickup roller shaft 134a, rotate in the clockwise direction. As a result, the pickup rollers 134 and 134' contact and pick up the sheets of paper P stacked in the paper cassette 120.

[0063] At this time, among the sheets of paper P, only an uppermost sheet of paper P is conveyed to the first and the second rive rollers 142, 142'; 144, 144' by a rotating force of the pickup rollers 134 and 134' and a friction resistance of the friction buckler 128 installed in the paper cassette 120.

[0064] Also, at this time, since the vector of force acting on the sheets of paper P by the pickup roller assembly 131, that is, its own weight and the gearing force of the first drive roller gear 143, acts in the same direction as the vector of the rotating force acting on the sheets of paper P by the pickup rollers 134 and 134', the pickup efficiency of the pickup rollers 134 and 134' is increased.

[0065] The sheet of paper P conveyed to the first and the second drive rollers 142, 142'; 144, 144' moves toward the feed roller 147 and the friction roller 149 without being subjected to any drag force since the first and the second drive rollers 142, 142'; 144, 144' rotate in the same direction as a paper pickup direction, that is, respectively in the clockwise and the counter-clockwise directions.

[0066] When the sheet of paper P almost arrives at the feed roller 147 and operates a paper sensor (not shown) installed in the vicinity thereof, a controller (not shown) stops rotation of the pickup rollers 13 and 134' after a predetermined time elapses, that is, after a leading end of the sheet of paper P is curled and aligned by a nip between the feed roller 147 and the friction roller 149. The controller then drives the driving motor 155 in the other direction, that is, the counter-clockwise direction (an arrow of dotted line in FIG. 3) to drive the feed roller 147 and the discharging roller 166.

[0067] As the driving motor 155 rotates in the counter-clockwise direction, the feed roller gear 148, connected to the shaft 155a of the driving motor 155 through the first and the second transmitting gears 156 and 157, rotates in the clockwise direction, and the friction roller 149 rotates in the counter-clockwise direction to feed the sheet of paper P.

[0068] As the feed roller gear 148 rotates in the clockwise direction, the swing gear 161 is swung by the swing lever and engaged with the second idle swing gear 163. As a result, the second drive roller gear 145 connected with the second idle swing gear 163 rotates in the counter-clockwise direction.

[0069] As the second drive roller gear 145 rotates in the counter-clockwise direction, the second drive rollers 144 and 144', positioned coaxially with the second drive roller gear 145 on the second drive roller shaft 144a, also rotate in the counter-clockwise direction, and thereby the first drive rollers 142 and 142' which contact the second drive rollers 144 and 144' with the second predetermined pressure, rotate in the clockwise direction.

[0070] At this time, since the first drive rollers 142 and 142' rotate in the clockwise direction, the roller hubs 171 and 171' of the spring clutches 170, 170' rotate in the anti-winding direction of the clutch springs 175 and 175'. Consequently, the clutch springs 175 and 175' are spaced from the outer circumferences of the roller and bushing hubs 171, 171'; 173a, 173a' while the inner diameters of the clutch springs 175 and 175'; increase due to the sliding friction force with the roller and bushing hubs 171, 171'; 173a, 173a', so that the first drive rollers 142 and 142' idle.

[0071] As the first drive rollers 142 and 142' idle, the driving force of the driving motor 155 is not transferred to the pickup driving gear 139 of the pickup roller assembly 131, and the pickup roller assembly 131 is again moved into the ascent position (the dotted line of FIG. 3) by the first elastic spring of the pickup roller assembly lifter 150.

[0072] Accordingly, while fed by the feed roller 147 and the friction roller 148, the sheet of paper P is moved to the image forming unit without being subjected to any interruption, for example, no drag force is caused by the first and the second drive rollers 142, 142'; 144, 144' and the pickup rollers 134, 134'. As a result, the paper feeding accuracy of the feed roller 147 is improved and paper skewing or paper jamming is prevented.

[0073] After that, the sheet of paper P is printed at the image forming unit, and then discharged by the discharging roller 146 and the discharging backup roller 167, which are connected with the driving motor 155 through the discharging roller gear train.

[0074] Referring to FIGS. 5 through 6B, a modified pickup roller assembly lifter 150' of the paper-feeding apparatus 100 is illustrated according to a second embodiment of the present invention.

[0075] The pickup roller assembly lifter 150' is installed with respect to the pickup roller assembly 131 and the paper cassette 120 .

[0076] The pickup roller assembly lifter 150' brings the pickup rollers 134 and 134' of the pickup roller assembly 131 into contact, with a fifth predetermined pressure with the sheets of paper P when the paper cassette 120 is mounted in the frame. The pickup roller assembly lifter 150' also separates the pickup feed rollers 134 and 134' from the sheets of paper P when the paper cassette 120 is detached from the frame.

[0077] The pickup roller assembly lifter 150' comprises a lift guiding groove portion 125 positioned at a top end of a side wall 123 of the paper cassette 120, a lifting shaft 151 having a projecting guide 153 at a first end thereof and supported rotatably on the frame to be raised and lowered by the lift guiding groove portion 125, a link member 154 installed between a second end of the lifting shaft 151 and the housing 133 of the pickup roller assembly 131 to move the pickup rollers 134, 134' into a descent position (FIG. 6B) contacting the sheets of paper P and an ascent position (FIG. 6A) separated from the sheets of paper P when the lifting shaft 151 is rotated by the projecting guide 153, and a pulling part 152 pulling the pickup roller assembly 131 in an upward direction to restore and maintain the pickup rollers 134, 134' of the pickup roller assembly 131at the ascent position.

[0078] The lift guiding groove portion 125 of the paper cassette 120, and the projecting guide 153 of the lifting shaft 151, are respectively provided with a locking groove 125a and a locking projection 153a that engage each other when the paper cassette 120 is completely mounted in the frame.

[0079] To easily rotate the pickup roller assembly 131 about the first drive roller shaft 142a, the link member 154 has a first link 154a having a first end fixed at the second end of the lifting

shaft 151, and a second link 154b having first and second ends supported rotatably at a second end of the first link 154a and the housing 133 of pickup roller assembly 131, respectively.

[0080] According to one aspect, the pulling part 152 comprises an extension spring having one end fixed at a third fixing projection 133b of the housing 133 of the pickup roller assembly 131, and the other end fixed at a fourth fixing projection (not shown) positioned at the frame. According to another aspect, the extension spring of the pulling part 152 is constructed to be fixed between the second link 154b of the link member 154 and the frame.

[0081] The operation of the modified pickup roller assembly lifter 150' constructed as above is as follows.

[0082] As is shown in FIG. 6A, assuming that the paper cassette 120 is not mounted in the frame, the paper cassette 120 in which sheets of paper P are stacked first moves in a direction of arrow A to be mounted in the frame.

[0083] At this time, as the projecting guide 153 is guided and raised along the lift guiding groove portion 125, the lifting shaft 151 rotates in a clockwise direction.

[0084] Accordingly, the first link 154a connected to the lifting shaft 151 rotates in the clockwise direction about the lifting shaft 151 to pull the second link 154b downwardly, and thereby the housing 133 of the pickup roller assembly 131 hinged with the second link 154b descends downwardly against the extension spring of the pulling part 152.

[0085] As is described above, when the paper cassette 120 is completely mounted in the frame, and thus the locking projection 153a of the projecting guide 153 is inserted in the locking groove 125a of the lift guiding groove portion 125, the pickup rollers 134, 134' are positioned at the descent position, and contact the sheets of paper P, as is shown in FIG. 6B.

[0086] Next, the operation of detaching the paper cassette 120 will be explained.

[0087] Firstly, the paper cassette 120 moves in a direction of arrow B to be detached from the frame, as is shown in FIG. 6B.

[0088] At this time, as the lift guiding groove portion 125 is ejected from the frame together with the paper cassette 120, the projecting guide 153, which urges the lifting shaft 151 to rotate in the clockwise direction, is released from the lift guiding groove portion 125.

[0089] As a result, by an extension force of the extension spring of the pulling part 152, the housing 133 of the pickup roller assembly 131 and the second link 154b are pulled and upwardly raised, and the lifting shaft 151 rotates in an counter-clockwise direction.

[0090] As the housing 133 of the pickup roller assembly 131 is raised, the pickup rollers 134 and 134' move to the ascent position, separated from the sheets of paper P, as is shown in FIG. 6A.

[0091] As is apparent from the foregoing description, it can be appreciated that the paper-feeding apparatus 10 of the image forming apparatus according to embodiments of the present invention can prevent paper feed troubles such as paper jams and paper skewing, and improve the paper-feeding accuracy of the feed roller 147, by removing the drag force generated by the first and the second drive rollers 142 and 144 during the line feeding of the paper P.

[0092] Also, the paper-feeding apparatus 10 can improve the pickup efficiency of the pickup rollers 134 and 134', by directing the vector of the force acted on the sheets of paper P by the pickup roller assembly 131, that is, its own weight and the gearing force of the pickup driving gear 139 or the force of the projecting guide 153 of the pickup roller assembly lifter 150', in the same direction as that of the rotating force acting on the sheets of paper P by the pickup rollers 134 and 134' during the pickup of paper.

[0093] Although a few embodiments of the present invention have been shown and described, it would be appreciated by those skilled in the art that changes may be made in this embodiment without departing from the principles and spirit of the invention, the scope of which is defined in the claims and their equivalents.